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HAEMATOLOGICAL PARAMETERS VARIATIONS WITHIN SEASON, AGE, SEX, PARITY, PREGNANCY IN CROSS BRED GOATS RAISED IN TIARET ALGERIA

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Abstract. The aim of this study was to determine the influence of season, age, sex, parity and pregnancy status on hematological parameters in goats raised in Tiaret, Algeria. Seventy-two cross bred local goats (Fifty-two females and twenty males), from 2018 to 2019, aged between three months and four years old were used. Goats were sampled in autumn and in spring. The age, sex, parity and the pregnancy status were noted. Jugular blood samples were collected via vacutainer tubes with (EDTA) early in the morning and brought to the laboratory within two hours for analysis. In all samples, the number of white blood cells (WBC), red blood cell (RBC), packed cell volume (PCV), haemoglobin (Hb), mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC), Lymphocytes, Monocytes, Neutrophils, Basophils and Eosinophils were determined. In our study, parity had a significant effect (p<0,05) on RBC, PCV, Hb, lymphocytes and monocytes. The mean value of the lymphocytes for females reported in our study was 3734,40±2208,84/mm^3 significantly lower (p<0,05) than 5575,60±2756,11 in males, while monocytes were significantly higher (p<0,05) in females with 946,13±964,10/mm^3 than 471±218,19/mm^3 recorded in males. The highest value of RBC's count, recorded in our work, was 11,33±3,29 x10^6/L in males and the lowest value in females with 10,58 ± 3,41 x10^6/mm^3. This work showed that age, season, sex, parity and pregnancy affected significantly haematological parameters in cross bred local goats raised in western Algeria.

Keywords: *Goats, season, age, sex, pregnancy, hematological parameters.*

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1. Introduction

The goats raised in Algeria are mainly composed of local breed animals without breed type, these animals are well adapted to the environmental conditions. The largest number of goats is distributed in the steppe and sub-saharian zones of Algeria (Moustaria, 2008). Goats are among the most fertile domestic animals, and their lack of development is still underestimated, especially with regard to their diet and their sanitary and reproductive management (Holtz, 2005). Haematological values are widely used to determine systematic relationship and physiological adaptation including the assessment of general health condition of animal (Kamal Shah *et al.*, 2007).

Many researchers have shown that the blood parameters of small ruminants are influenced by many factors such as age (Mbassa & Poulsen, 1991), geographical

locations, climate, gender, season, breed (Azab & Abdel-Maksoud, 1999; Anwar *et al.*, 2012; Donia *et al.*, 2014; Bagnicka *et al.*, 2014; Ribeiro *et al.*, 2016), and the physiological stages of production (Donia *et al.*, 2014; Piccione *et al.*, 2012; Sadjadian *et al.*, 2013).

It is evident that blood parameters levels can be used as diagnosis and prognosis criteria of metabolic diseases, as well as for nutritional status assessment (Bagnicka *et al.*, 2014; Tanritanir *et al.*, 2009). Many studies inspected biochemical and haematological parameter levels for numerous goat breeds all around the world (Mbassa & Poulsen, 1991; Azab & Abdel-Maksoud, 1999; Rastogi & Singh, 1990; Kumar *et al.*, 1997; Njidda *et al.*, 2013), a great variation in the haematological and biochemical parameters as observed between breeds of goats (Azab & Abdel-Maksoud, 1999) and in this regard, it may be difficult to formulate a universal metabolic profile test for goat (Opara *et al.*, 2010). The aim of this study was to determine the influence of season, age, sex, parity and pregnancy status on haematological parameters in goats raised traditionally in Tiaret, Algeria.

2. Materials and Method

The present study was conducted in seventy-two cross bred local goats (Fifty-two females and twenty males), from 2018 to 2019, aged between three months and four years old. Animals belongs to different farms in Tiaret at the north-west Algeria. Animals were provided with barley, seasonal available fodder and water, was available *ad libitum*.

Goats were sampled in Autumn and in spring. The age, sex, parity and the pregnancy status were noted. Jugular blood samples were collected via vacutainer tubes with (EDTA) early in the morning and brought to the laboratory within two hours for analysis.

In the whole blood samples, the number of white blood cells (WBC), red blood cell (RBC), packed cell volume (PCV), haemoglobin (Hb), mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration(MCHC), Lymphocytes, Monocytes, Neutrophils, Basophils and Eosinophils were determined using an automatic cell counter (Roche® COBAS Integra 400). For each parameter, mean and standard deviation values were determined and a statistical analysis using SPSS IMB 20 and the ANOVA1 test was made to determine the influence of pregnancy, parity, season, sex and age.

3. Results and discussion

It was reported that haematological and biochemical parameters of animals may vary based on factors like breed, age, and sex (Njidda *et al.*, 2013).The parameters values, recorded in our work, were similar to those reported by authors (Egbe-Nwiyi *et al*., 2000; Tibbo *et al*., 2004).

In our study, gender had a significant influence ($p<0,05$) on lymphocytes and monocytes values (Table1). The mean value of the lymphocytes for females reported in our study was $3734,40\pm2208,84/mm^3$ significantly lower ($p<0,05$) than in males with $5575,60\pm2756,11/mm^3$ while monocytes were significantly higher ($p<0,05$) in females with $946,13\pm964,10/mm^3$ than recorded in males with $471\pm218,19/mm^3$.

Table 1. Haematological parameters values variation within goat's sex

Parameters	*Females*		*Males*		*All*	
	N	*Mean±SD*	*N*	*Mean±SD*	*N*	*Mean±SD*
RBC (x10^6/L)	52	10,58±3,41	20	11,33±3,29	72	10,79±3,37
WBC (/ml)	52	9082,69±4019,40	20	10300,00±3437,56	72	9420,83±3881,81
PCV (%)	52	24,65±5,46	20	26,35±6,11	72	25,13±5,65
Hb (g/dL)	52	7,55±1,98	20	8,58±2,23	72	7,84±2,09
MCV (fl)	52	24,52±5,73	20	23,63±2,58	72	24,27±5,05
MCH (pg)	52	30,80±4,86	20	32,42±2,21	72	31,25±4,34
MCHC (g/dl)	52	7,40±1,45	20	7,65±0,82	72	7,47±1,30
Lymphocytes (/mm^3)	52	3734,40±2208,84*	20	5575,60±2756,11	72	4245,85±2495,41
Monocytes (/mm^3)	52	946,13±964,10*	20	471,80±218,19	72	814,38±852,16
Neutrophyles(/mm^3)	52	4016,37±2567,99	20	3785,30±1855,92	72	3952,18±2381,08
Basophiles (/mm^3)	52	92,00±147,16	20	82,80±110,78	72	89,44±137,32
Eosinophiles(/mm^3)	52	366,21±337,59	20	384,50±195,47	72	371,29±303,57

**Refers to a significant difference in the same line (p<0,05)*

The highest value of RBC's count, recorded in our work, was 11,33±3,29 x106/L in males and the lowest value in females with 10,58±3,41 x106/mm^3. In addition, the lowest mean Hb concentration was observed in females with 7,55±1,98 g/dl against 8,58 ± 2,23 g/dl in males without significant difference (p>0,05). The highest WBC's mean value was 10300,00±3437,56/mm^3 in males, while the lowest values were recorded in females with 9082,69±4019,40/mm^3 (p>0,05). However, those values are lower WBC levels were determined for Kano Brown goats as 18,3±0,65 x109/L for males and 20,3±1,33x109/L for females, while in Borno White goats it was determined as 13,3±0,6 x109/L for males and 33,4±0,4 x109/L for females (Çelik *et al*., 2019).

In this study, age had a significant influence (p<0,05) on the measured parameters, PCV and Hb values were significantly (p<0,05) higher in animals aged from 3 to 5 months, respectively 31,00±5,83% and 10,40±2,45 g/dl (Table 2). This result is in line with reports of no statistical difference in MCH and Hb levels between males and females Saneen goat's older than 8 months (Elitok, 2012), while in Borno White goats (adult males and young females) had statistically higher MCV values (Njidda *et al*., 2013).

The highest RBC's count mean value was 13,20±2,58 x106/L observed in animals aged between 3 and 5 months, while the lowest mean value of 7,20±0,84 x106/L was recorded in those aged 5 years but without significant difference (p>0,05). The observed difference in adult and young goats was explained by the oxygen carrying capacity of the blood was high in adult goats (Njidda *et al*., 2013).

The lowest mean Hb value was observed in five years old goats with 5,65±0,63 g/dl compared to 7,70±1,79 g/dl in one year old animals, were the highest WBC's count was 10920,00±3522,87/ml in animals aged from 7 to 9 months and the lowest mean value was recorded in those aged five years with 5000,00±2262,74/mm^3. For monocytes, we also observed a very remarkable increase in the mean values of goats aged between one and five years without significant deference (p>0,05) in all the categories studied.

In our study, pregnancy had a significant influence (p<0,05) on RBC, Hb, MCV, MCH, MCHC and lymphocytes. the highest RBC's mean value was recorded in non-pregnant females with 12,18±3,04 x106/L, while the lowest values were recorded in pregnant females with 9,10±3,08 x106/L which is in agreement with some authors (Tharwat & Al-Sobayil, 2013), but in contradiction no significant difference between pregnant and non-pregnant goats was reported (Pospisil *et al*., 1987).

Table 2. Haematological parameters values variation within goat's age

Parameters	***3 to 5 months***		***7 to 9 months***		***1 year***		***2 years***		***3 years***		***4 years***		***5 years***	
	N	***Mean±SD***	***N***	***Mean±SD***	***N***	***Mean±SD***	***N***	***Mean±SD***	***N***	***Mean±SD***	***N***	***Mean±SD***	***N***	***Mean±SD***
RBC (x10^6/L)	4	13,20 ±2,59	10	12,21 ±3,75	11	10,79 ±3,22	22	10,61 ±3,17	12	9,96 ±2,48	11	10,52 ±4,45	2	7,20 ±0,85
WBC (/ml)	4	10900,00 ±1700,98	10	10920,00 ±3522,88	11	8463,64 ±2481,24	22	10500,00 ±4234,44	12	7350,00 ±3266,50	11	9381,82 ±4810,37	2	5000,00 ±2262,74
PCV (%)	4	31,00±5,83*	10	27,40±7,89	11	26,00±6,20	22	23,09±4,15	12	23,08±2,68	11	27,36±5,68	2	19,50±0,71
Hb (g/dL)	4	10,40±2,45*	10	8,88±2,58	11	7,71±1,79	22	7,38±1,82	12	7,25±1,26	11	8,05±2,36	2	5,65±0,64
MCV (fl)	4	23,55±1,18	10	22,52±2,46	11	24,76±4,33	22	22,79±4,77	12	23,91±3,39	11	28,45±8,05	2	27,33±4,21
MCH (pg)	4	33,32±1,75	10	32,64±3,45	11	30,07±4,27	22	31,98±5,45	12	31,34±3,35	11	29,28±3,94	2	29,05±4,31
MCHC (g/dl)	4	7,87±0,62	10	7,35±1,14	11	7,38±1,27	22	7,14±1,19	12	7,45±1,09	11	8,14±2,02	2	7,85±0,04
Lymphocytes (/mm^3)	4	5245,50 ±964,62	10	5452,20 ±2666,34	11	3820,55 ±1991,57	22	4713,64 ±2563,30	12	3790,50 ±2447,36	11	3148,64 ±2865,60	2	2175,00 ±190,92
Monocytes (/mm^3)	4	475,50 ±178,02	10	389,60 ±156,38	11	878,36 ±1074,82	22	801,73 ±970,70	12	1014,33 ±1030,66	11	1106,64 ±629,94	2	596,00 ±650,54
Neutrophyles(/mm^3)	4	4650,00 ±1007,90	10	4573,20 ±3131,41	11	2926,18 ±1620,59	22	4461,27 ±2320,78	12	2932,50 ±1683,99	11	4630,82 ±3001,56	2	1880,00 ±1168,14
Basophiles (/mm^3)	4	56,00±64,75	10	66,00±96,98	11	62,36±99,30	22	130,55±203,64	12	50,50±74,96	11	120,55±108,51	2	33,00±46,67
Eosinophiles (/mm^3)	4	473,00 ±158,58	10	439,00 ±174,69	11	321,64 ±218,97	22	410,82 ±375,02	12	259,67 ±275,50	11	375,18 ±397,23	2	316,00 ±206,48

**Refers to a significant difference in the same line ($p<0,05$)*

The decrease in the number of red blood cells at the end of gestation was explained by the stress associated with parturition and lactation (El-Ghoul, 2000). However, mean Hb concentration was lower than in pregnant females with 6,82±1,58g/dl than in non-pregnant ones 8,34±2.09 g/dl which is consistent with authors results with 6,23±1,64 g/dl (Tshiasuma, 2018).

Table 3. Haematological parameters values variation in pregnant and non-pregnant goat's

Parameters	***Non pregnant***		***Pregnant***	
	N	***Mean±SD***	***N***	***Mean±SD***
RBC (x10^6/L)	25	12,18±3,04*	25	9,10±3,19
WBC (/ml)	25	9600,00±3343,65	25	8412,00±4454,62
PCV (%)	25	25,72±5,70*	25	24,08±5,06
Hb (g/dL)	25	8,34±2,09	25	6,89±1,63
MCV (fl)	25	21,63±3,55	25	27,69±5,88*
MCH (pg)	25	32,63±5,24*	25	28,79±3,54
MCHC (g/dl)	25	6,99±1,26	25	7,87±1,55*
Lymphocytes (/mm^3)	25	4494,16±2399,43	25	2872,28±1651,10
Monocytes (/mm^3)	25	1009,36±1035,98*	25	903,00±943,11
Neutrophiles(/mm^3)	25	3961,04±2128,65	25	4060,92±3023,33
Basophiles (/mm^3)	25	99,84±143,30	25	60,96±107,29
Eosinophils(/mm^3)	25	383,20±250,88	25	317,88±350,53

**Refers to a significant difference in the same line (p<0,05)*

This decrease of Hb concentration can be explained by haemodilution which could maintain and prevent a marked decrease in O2 content in the blood. The diffusion of O2 from maternal to foetal blood is dependent on the difference in O2 tension in the maternal and foetal blood, so a marked decrease in haemoglobin may result in reduced intake O2 to the foetus (Guyton, 1996).

The highest WBC's count was 9600,00±3343,65/mm^3 recorded in non-pregnant while the lowest values were 8603,70±4568,83/mm^3 in pregnant females. In this study, MCV and MCH of pregnant females were significantly (p<0,05) higher than in non-pregnant females, this is in agreement with authors reports (Azab & Abdel-Maksoud, 1999).

In our study, parity had a significant effect (p<0,05) on RBC, PCV, Hb, lymphocytes and monocytes. The highest RBC's count value recorded in our work, was 12,35±2,94 x106/L in nulliparous goats with 9,93±3,39 x10^6/l.

The mean Hb concentration was observed in primiparous females with 6,71±1,61 g/dl compared to 8,82±2,21 g/dl in goats. The highest number of leukocytes recorded was 10900,00±4396,21/mm^3 in primiparous, while the lowest values were recorded in multiparus with 7776,92±4060,87/mm^3.

For goats, the WBC level was reported to be between 4000-13000/mm^3 (Kramer, 2000; Siliart & Nguyen, 2007). The WBC's count was significantly higher (p<0,05) and the PCV was significantly lower (p<0,05) in primiparous than multiparus and nulliparous goats. We have also noted a significant low mean Hb concentration in primiparous with 6,71±6,61 g/dl against 8,82±2,12 g/dl and 7,34±1,82 g/dl in nulliparous and multiparous goats respectively.

Table 4. Haematological parameters values variation in primiparus, multiparus and young goat's females

Parameters	*Primiparus*		*Multiparus*		*Nulliparous*	
	N	*Mean±SD*	*N*	*Mean±SD*	*N*	*Mean±SD*
RBC (x10^6/L)	13	10,11±3,50	26	9,93±3,39	13	12,35±2,94*
WBC (/ml)	13	10900,00±4396,21	26	7776,92±4060,87	13	9876,92±2650,21
PCV (%)	13	22,23±5,56*	26	24,38±4,44	13	27,62±6,21
Hb (g/dL)	13	6,71±1,61*	26	7,34±1,82	13	8,82±2,12
MCV (fl)	13	23,30±6,13	26	26,12±6,37	13	22,55±2,46
MCH (pg)	13	30,82±6,13	26	30,11±4,64	13	32,18±3,87
MCHC (g/dl)	13	6,98±1,46	26	7,68±1,49	13	7,29±1,33
Lymphocytes (/mm^3)	13	3975,23±1847,80	26	3014,65±2106,39*	13	4933,08±2309,97
Monocytes (/mm^3)	13	1421,85±1360,36	26	964,65±861,28	13	433,38±153,71*
Neutrophyles(/mm^3)	13	4573,08±2613,17	26	3749,58±2726,98	13	3993,23±2283,67
Basophiles (/mm^3)	13	172,77±220,81	26	69,46±117,88	13	56,31±69,16
Eosinophiles(/mm^3)	13	372,46±427,95	26	315,73±352,68	13	460,92±163,69

**Refers to a significant difference in the same line (p<0,05).*

Nulliparous goats had a significantly lower (p<0,05) mean value of monocytes with 433,38±153,71/mm^3 than primiparous and multiparous goats respectively with 1421,85±1360,36/mm3 and 964,65±861,28/mm^3.

In this study, season had also a significant influence on Hb and MCH (p<0,05). The highest RBC count recorded was 10,87±3,52 x106/mm^3 in autumn while the lowest values were recorded in spring with 10,33±3,35 x106/mm^3.

In addition, the lowest mean haemoglobin concentration was observed in autumn with 7,40±1,55 g/dl against 7,69±2,31 g/dl in spring.PCV value obtained in autumn was 26,42±4,58% and in spring was 23,14±5,77% close to those reported (Tibbo *et al*., 2004) respectively for the two season with 26,35±0,46% and 26,42±0,43%, however higher values for autumn with 28,18±4,08% and for spring 33,05±4.38 g/dL was also reported (Siliart & Nguyen, 2007). Various researchers have reported that Hb and PCV values are affected by the altitude of the animals, and their nutrition (Egbe-Nwiyi *et al*., 2000; Adejumo, 2004). Increase in PCV values may be attributing to increase in environmental temperature (Isidahomen *et al*., 2010). High PCV values indicates either an increase in the number of circulating RBC or reduction in circulating plasma volume (Kopp & Hetesa, 2000).

Table 5. Haematological parameters values variation within season in goat's females

Parameters	*Automne*		*Spring*	
	N	*Mean±SD*	*N*	*Mean±SD*
RBC (x10^6/L)	24	10,9±3,5	28	10,3±3,4
WBC (/ml)	24	8879,2±3460,7	28	9257,1±4499,5
PCV (%)	24	26,4±4,6	28	23,1±5,8
Hb (g/dL)	24	7,4±1,5*	28	7,7±2,3
MCV (fl)	24	25,9±6,9	28	23,3±4,2
MCH (pg)	24	28,2±4,1*	28	33,0±4,4
MCHC (g/dl)	24	7,2±1,9	28	7,60,9±
Lymphocytes (/mm^3)	24	3443,5±2140,9	28	3983,7±2274,2
Monocytes (/mm^3)	24	941,0±1021,2	28	950,6±931,3
Neutrophyles(/mm^3)	24	3877,0±2271,7	28	4135,8±2833,4
Basophiles (/mm^3)	24	61,9±87,1	28	117,8±181,5
Eosinophiles(/mm^3)	24	350,5±341,8	28	379,6±339,6

**Refers to a significant difference in the same line (p<0,05).*

The highest WBC count was recorded in spring with 9257,14±4499,50/ mm^3, while the lowest value were recorded in autumn with 8879,17±3460,71/mm^3. It was showed that all Wintrobe indices (PCV, MCH and MCHC) were higher during the long rainy season, except that the MCHC was also high during the short rainy season, which is contradiction with what was reported in our study for the MCHC (Tibbo *et al.*, 2004).

4. Conclusion

This work showed that age, season, sex, parity and pregnancy affected significantly haematological parameters in cross bred local goats raised in western Algeria and it must be taken in consideration when haematological analysis are done in order to investigate pathologies in goats.

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